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ON THE CURRICULUM OF MATHEMATICS.*

BY ISAAC J. SCHWATT.

It would appear that the processes of education have been carried on long enough to have established a fixed educational policy. The prevalent conflicting ideas and the present unrest in education indicate, however, that it is only in the beginning of its experimental stage and that educators are not, as yet, agreed on many of the most fundamental questions of their calling.

There are two markedly differing tendencies in educational methods today. One is to carry on instruction in such a manner as to make the knowledge gained appear practical; to supply the pupil with such information as, it is assumed, he can actually use in the ordinary pursuits of life. The other tendency is to emphasize the cultural value of knowledge with little regard to its utilitarian purpose.

In considering how much of the knowledge obtained at school a person actually uses in his daily work, we must not forget that the majority of men and women are artisans, mechanics, clerks, or followers of the many other occupations which are indispensable to the common good. I have failed to find, in any of the ordinary pursuits of life, the slightest trace of any direct application of the mathematics taught in the elementary schools, high schools, and colleges, beyond operations with simple fractions and comparatively small integers. Followers of the different occupations soon learn to perform these arithmetical operations with facility, and very often in a more effective manner than that which they have practiced at school. Even the engineer, greatly as it is to be deplored, is using more and more the ready-made data of the hand-books issued by manufacturing establishments. We can easily convince ourselves whether or not the mathematical disciplines find application in the daily pursuits of the average person. For such an inquiry we do not need elaborately equipped laboratories, complicated instruments, or well-stocked libraries. The members of our own family, our neighbors, any person we meet on the street and who may be willing to give us the information we ask, contribute to prove that mathematics has little application in the life of the average person. It is true that the principles of geometry enable us to measure the height of a tree if the sun shines brightly and the tree is not obstructed by surrounding trees, and if we have a long enough pole at our disposal; that the game of base ball, of pool and of many others are based on geometrical and mechanical principles. But no one would suggest that geometry shall be studied for such and similar purposes in life.

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*Read at the annual meeting of the Association of Mathematical Teachers in New England, Boston, December 28, 1909.

The purpose of the study of any mathematical discipline is the development of the mind of the learner. The principles of mathematics do not contain even the interesting information of many of the other subjects of the curriculum. It is immaterial to the average person whether the sum of the angles of a triangle is two right angles, or more or less. Unless a person is benefited by the mental training which the study of such theorems is capable of giving, the knowledge and information gained must be considered a waste of time and energy to him. If mathematics cannot help the learner to gain power of mind, I for one am heartily in accord with those educators who suggest that the study of mathematics be eliminated from the secondary schools.

It is extremely unfortunate that there is a tendency to force into some of the subjects of the curriculum a quality that they do not naturally possess. This is bound to influence in a pernicious manner the teaching of these subjects. It is held that all studies have the quality of developing power of mind; but, if a subject be taught with reference to its practical application, it may happen that neither the one nor the other purpose of education will be accomplished. Any work that the pupil does in a subject because it may find application in life, tends only to develop and strengthen utilitarian and mercenary qualities in him, and the desire of immediate reward and gain.

We are prone to judge of circumstances and conditions from those immediately surrounding us. This is the reason why especially in more intelligent circles, there is not attached to education as a means for developing mental faculties and for increasing common sense, as much importance as it deserves. Yet if the normal equilibrium of society is disturbed we soon find that most people are not always able to exercise the best judgment in governing their affairs. Education is in fact the only hope for bettering conditions.

Considering the manifold and varied occupations and professions necessary to meet all the needs of modern society, it is manifestly impossible for the school to teach, even superficially, all the subjects relating to these needs, and at the same time develop in the student the moral and intellectual powers that are indispensable to true success in life. Whatever the occupation of a person, he is in need of character and the powers of mind that are awakened, developed, and strengthened by a proper education.

There are many things which a person must know to take his position in the world. There is much knowledge the acquisition of which adds greatly to the enjoyment of life. We should know the reasons for the phenomena occurring about us. One who does not understand the workings of nature cannot participate in the greatest enjoyment bestowed upon mankind. There are also questions pertaining to economic conditions which every citizen should thoroughly understand.

The school should develop and cultivate in the young a taste for good music. While listening to it, the noblest instincts are aroused, and the most tender emotions are awakened in those who have acquired an understanding of it. It is desirable that the school should train the eye and the ear, and develop the various latent faculties in the young. The school should train the pupil to be handy with tools, a desirable accomplishment in every household. But mental development should not be sacrificed to the acquirement of manual skill. Since the young especially find mental effort the hardest task, they readily take to manual work which calls for little mental application rather than to such studies as require concentrated thought.

It is our belief that good health, good character, and power of mind are the best assets with which to start life. With these qualifications the youth will be better equipped for any work and be more successful in the true sense of the word than if he has learned how to make a candlestick when he is to become a banking clerk. Mechanics and artisans who possess great skill are greatly handicapped in their work if they do not have the power of mind to apply their skill in an advantageous manner.

Since the school cannot teach all the subjects which may be useful or interesting in life, it must select those which will serve best the true purposes of education, which will awaken, develop and strengthen those qualities which we all must possess, whatever our occupation. These, as stated before, are character and power of mind. Just as it requires different ingredients to make up the diet necessary to keep all the bodily organs healthy, strong, and in a harmonious state of development, so the mind needs variety of training for its proper expansion. For the curriculum such subjects must be selected as, blended together, will afford the best means for the development of character and mind. In making such a selection, special attention should be paid to the student's age and to the state of his mental progress. There is a tendency to extend the elective system, now in vogue in some of the colleges, to the secondary schools, that is, to select for the individual student such subjects as seem best fitted to his state and to his personal preference. Such a course ought to be pursued when the student is choosing his life work and not while he is getting a general education. If a selection of subjects is advisable, the courses which in the secondary school or in the college the student ought to choose, must not be those for which he is best fitted, or which he can easily learn, or for which he has a special taste and inclination, but they must be such as will develop in him those desirable faculties which he lacks, or those qualities of mind which in him are less strong than others. In this way the student will approximate to a perfect man or woman. It ought to be the duty of the teacher to study the faculties, abilities and capabilities of the student in order that he may be able to advise him as to what occupation or profession he is best fitted for. The importance of the teacher's services in this respect cannot be overestimated.

Parents are often inclined to leave the choice of a profession or occupation with their children. Now the young are, as a rule, attracted to an occupation more by exterior appearances or by the promise of lucrativeness than by their fitness for it. It is preposterous to allow a young man of sixteen or eighteen with no knowledge of the world and the things in it, to choose for himself his life work. There are men and women, who, although they perform the duties of their present occupation satisfactorily, might be better fitted for some other occupation and in which they could do more good to themselves and to their fellowmen.

In a properly arranged scheme of studies an undue amount of time and energy should not be devoted to any one subject at the expense of another. A person trained, for instance, in mathematics without having enjoyed the benefit to the mind resulting from other studies, would be in a similar position to the newly arrived Finnish girl of whom the following is related: A lady who wished to engage her services tried, through an interpreter, to find out what her accomplishments were. Having been brought up in a rather crude civilization, the girl was naturally unfamiliar with the requirements of a well-to-do American household. The lady, having formerly had favorable experiences with foreign help, pressed the interpreter to discover some accomplishment which the girl might possess. The interpreter finally joyfully reported that the girl could milk a reindeer.

Power of mind can be acquired from clear ideas only. Character can be developed by exercising and practicing the virtues which constitute it. The purpose of education is to accomplish both. I was greatly interested in the preliminary report issued a few weeks ago by the United States Immigration Commission. This report which was prepared with the assistance of expert anthropologists, shows conclusively that the physical form of the descendents of some of the European immigrants is different from that of their ancestors. Children born a few years after the arrival of their parents in this country, develop a different form of head from that of their parents, notwithstanding that the head has always been considered one of the most persistent hereditary features of a race. This goes to show that the individual is influenced by environment to a much greater extent than has been supposed. Just as a change in economical, social and climatic conditions produces a change in the physical form of the individual, so education should produce a change in the character and mind of the pupil. Education will accomplish this, if its work be as thorough, as steady, and effective, as the ever present influence of environment.

Education depends on a variable, the requirements of life. It depends not only on the magnitude but also on the intensity of this variable. The purpose of education now is the same as it was centuries ago. But as the demands of life are so much greater today than in former years when temptations were few and competition was mild, the intensity of education must be correspondingly increased.

I feel that the curriculum of our high schools is, on the whole, modeled after the course of study of some of the foreign gymnasiums, more especially after the German. But the conditions in this country differ widely from those in foreign nations. Even today in some of these, very few enter these schools, except those intending to take up a profession. I have examined the programs (for the year 1908) of some widely scattered gymnasiums and I have found that nearly all the graduates have indicated their intention to take up a profession. In this country, however, a very small percentage of high school pupils continue their studies in a university and a large percentage of these take liberal college courses only.

Since the opportunity of attending high school is enjoyed by comparatively few, and still fewer have the privilege of attending college, it is the duty of the higher schools to see that all their students shall gain such qualifications as will fit them for true leadership among their fellowmen. They shall be missionaries for all that is right and just, and good and noble.

In this connection there is a question which I have not been able to answer. Since the high schools and colleges educate only a very small percentage of the youths of the country, shall the college attract only the ablest and the most promising youths and prepare them for true leadership in the sciences, in the arts, and in all activities of life; or shall the college admit all those who are sufficiently prepared to pass the entrance examinations? Under the present system, however, it is the duty of the teacher to pay especial attention to those students who are least gifted and who need our help most.

There is no doubt that, on the whole, our teaching has not been effective in imparting to our students perfectly clear ideas of the mathematical subjects taught. In addition to those causes for the failure of our efforts which I have discussed before the Association of Teachers of Mathematics of the Middle States and Maryland, I believe that some of the subject matter in mathematics ordinarily taken up in elementary and secondary schools is beyond the age and capability of the average pupil. He may acquire some proficiency in performing operations but, as a rule, is not capable of attaining a perfectly clear understanding of the principles and ideas underlying them.

In education quality is the only decisive factor. Unless the pupil acquires perfectly clear ideas of every point of the ground covered, the instruction must be considered a failure and a waste of time and energy. One clear idea which is entirely the pupil's own mental possession is of infinitely greater benefit to his development, than if he were to go over a great amount of ground without gaining a thorough understanding of it. Some of us may recall that we were not always able to gain a perfectly clear conception of the principles and ideas we studied at school. Sometimes it was because we were not allowed sufficient time for the ideas to grow on us, so to speak. More often, however, it was the state of our mental development, even though it was normal for our age. It is not possible for the average high school pupil to gain perfectly clear ideas of each subject of secondary mathematics and to derive the mental benefit which their study is capable of yielding. It takes greater maturity than is possessed by the average high school pupil to thoroughly understand some of the principles of demonstrative geometry, for instance, and to acquire facility in solving constructions. On that account, if in the high school with a four years' course mathematics is taught only during a part of the time, it ought to be taken up during the last years, when the student is more mature and is better prepared to follow the instruction.

(*To be continued.*)